Supplemental Document

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Imaging fine structures of the human trabecular meshwork *in vivo* using a custom design goniolens and OCT gonioscopy: supplement

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Supplemental material for “Imaging fine structures of the human trabecular meshwork in vivo using a custom design goniolens and OCT gonioscopy”

Fabricating an index-matched 3D printed goniolens for high resolution imaging

We present a step-by-step guide on the fabrication process of our 3D printed, index-matched goniolens.

1. Parts needed

- SolidWorks™ part file (.SLDPRT) for the body part: Goniolens body part_3Dprinted.SLDPRT shown in Code 1.
- PPO2 contact lens: 12 mm diameter and 0.3 mm thickness 0 diopter power contact lens, with a 7.85 mm base curve.
- Edmund Optics™ #46-647: 2 flat mirrors 9 mm diameter and 1mm thick protected aluminum with 4-6λ surface flatness peak-to-valley.
- Edmund Optics™ #23-430: 30 mm diameter, 1 mm thick, N-BK7 flat window with λ/4 surface flatness and NIR-I coated.
- Thorlabs™ AC127-030-B achromat, 30 mm focal length lens with a NIR-I anti-reflection coating.
- Thorlabs™ LA4327-B plano-convex, 75 mm focal length lens with a NIR-I anti-reflection coating.
- Thorlabs™ LA1213-B plano-convex, 50 mm focal length lens with a NIR-I anti-reflection coating.
- Edmund Optics™ #45-796 achromat, 40 mm focal length lens with a NIR-I anti-reflection coating.
- Aluminum tube of 0.5” diameter, 10 mm length and 0.75 mm thick wall.
- Aluminum tube of 0.5” diameter, 15 mm length and 0.75 mm thick wall.
- Aluminum spacer ring to just fit inside the 0.5” diameter tube, 1.8 mm long and 1mm thick.
- Aluminum spacer ring to just fit inside the 0.5” diameter tube, 5.46 mm long and 1mm thick.
- Two retaining rings to fit the 0.5” diameter tube.
- Birchwood Casey™ Aluminum Black metal finish.
- Thorlabs™ SM30L03: 30 mm diameter lens tube: 0.33" long and 0.30" thread depth.
- Neoprene rubber gasket material of 1 mm thickness.
- Pure vegetable glycerin, 8.9g.
- Distilled water, 25 ml.
- Isopropyl alcohol for disinfecting.
- Vacuum Degassing Chamber with 5 CFM (Cubic Feet per Minute), 1/3 horsepower Single Stage Pump.
- Musou Black™ paint (KOYO Orient Japan Co., Ageo, Saitama, Japan).
- Norland™ NOA 61 glue with UV light gun.
- Norland™ NOA 68 glue with UV light gun.
- DAP™ RapidFuse instant adhesive.
- J-B Weld™ 50133 2-part plastic bonder structural adhesive.

- Small paint brush.

2. Methods

1. Download the SolidWorks™ part file (.SLDPRT) for the body part from the supplemental material.
2. 3D print the body part design with 420i – 420 Stainless Steel/Bronze by metal binder jetting and tumble polished from Xometry™ (North Bethesda, Maryland, USA).

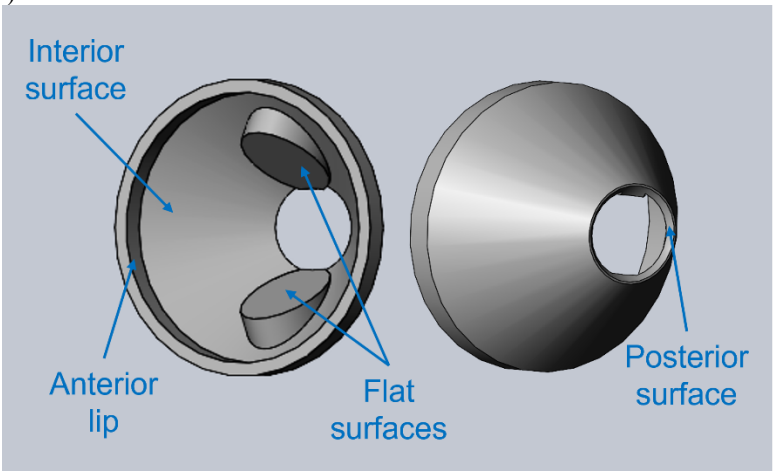

Figure 1S: Design of the 3D printed goniolens body viewed from two different angles indicating relevant surfaces.

3. Clean the goniolens body with isopropyl alcohol. After letting it dry, paint the interior of the goniolens body (see Figure 1S) with two coats of Musou Black™ paint, letting dry between coats. Do not paint over the 59° and 63° angled flats, or the posterior 11mm diameter edge of the goniolens body.
4. Use the small paint brush to place a thin layer of Norland NOA 68 glue evenly around the posterior edge of the goniolens body and place the contact lens centered on the posterior surface, ensuring that there are no gaps. Lightly hold the contact lens in place with a clean cotton swab while curing the glue with the UV light gun. UV light should reach all areas of glue and be aimed in all directions.
5. Use a small drop of DAP RapidFuse to glue the flat mirrors centered on to the 59° and 63° angled flats and let dry for 24h.
6. Apply a thick coat of the 2-part plastic bonder to the inner and superior edge of the anterior lip of the goniolens body as well as to the external threads of the tube lens and glue together. Apply pressure for several minutes and let dry for 24h.
7. Cut the neoprene rubber sheet into a 31 mm outer diameter and 26 mm inner diameter ring and place it on the inner retention ring of the tube lens.
8. Add 8.9g of glycerin to distilled water to form 25 ml of solution (35.6% concentration) and mix until uniform. Observe in a glass beaker while mixing until solution is clear without refractive distortions. Place a beaker with the solution in the degassing chamber for approximately 15 min at 0.8 ”Hg. Small degassing bubbles will rise to the surface but with too low a pressure or too long a time large bubbles will form due to ‘boiling’ at the low pressure. Do not allow this to occur.
9. Disinfect both the interior of the goniolens body and the gasket with isopropyl alcohol. Pour the glycerin solution into the goniolens until it is overfilled.
10. Place the flat glass window in the tube lens over the gasket avoiding any trapped air bubbles, and secure in place with the tube lens’ retaining ring.

11. Use the instructions of the aluminum black to coat all the aluminum tubes, spacers and retaining rings.
12. Place the Thorlabs™ LA4327-B lens in the 10 mm length aluminum tube and place them on the glass window centered over the 59° angled mirror. Use a drop of the Norland NOA 61 on the glass window to glue both the lens and the tube in place. Cure with the UV light gun. Insert the 1.8 mm long spacer ring into the tube and the Thorlabs™ AC127-030-B over it. Secure in place with a retaining ring.
13. Place the Thorlabs™ LA1213-B lens in the 15 mm length aluminum tube and place them on the glass window centered over the 63° angled mirror. Use a drop of the Norland NOA 61 on the glass window to glue both the lens and the tube in place. Cure with the UV light gun. Insert the 5.46 mm long spacer ring into the tube and the Edmund Optics™ #45-796 over it. Secure in place with a retaining ring.